Remarks upon and Experiments with Faure's Secondary Battery.

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At the last meeting of the society I had the honour of showing a modification of Plante's secondary battery, as made by M. Faure. Since that meeting I have been able to make several interesting experiments with it. Before relating these experiments, I may be permitted to shortly describe the construction of Faure's battery after the manner found by me to be most advantageous. Each cell is made up as follows:—Two sheets of felt, 12 x 36 inches; two sheets of lead, $5\frac{1}{2}$ x 30 inches; one sheet of vegetable parchment, $12\frac{1}{2}$ x 36 inches. The felt was laid on a flat surface, and coated with a paste consisting of red oxide of lead and dilute sulphuric acid, one to ten. A sheet of lead was then placed within half-an-inch of one edge of the felt; the remaining coated surface folded over. Of the two sheets thus prepared one was covered with vegetable parchment, then placed one on top of the other, rolled together, and immersed in dilute sulphuric acid.

Four cells prepared in this way were connected together as one cell, and charged by means of two Callans cells, operating for two hours. They were then disconnected. One cell was found capable of rendering two inches of No. 17 platinum wire (about as thick as bell wire) red hot. With four connected for quantity 5 inches of No. 17 platinum wire became incandescent.

Connected in series N P N P with a large inductorium an effect equal to that producible by six Callans was obtained.

The secondary cells after standing twenty-four hours were still capable of working that instrument as powerfully as two Callans, and afterwards being put on to an electromotor, the latter worked for half-an-hour without any apparent diminution of speed.

Four Faure's cells charged for two hours with two Callan elements, and then connected in series, decomposed acidulated water in the voltameter as follows:—

I. 60 C.C. ... ... in 30 minutes.
II. 60 „ ... ... 40 „

III.	60 C.C. ...	...	...	70 minutes
IV.	60 „ ...	...	...	100 „
V.	60 „ ...	...	...	160 „
VI.	60 „ ...	...	...	240 „

Two Callans cells, as compared with the above, gave 60 cubic c.c., in 220 minutes.

Of four cells charged as before, three were taken out of the acid and drained, then packed in a box with sawdust. After three hours they seemed as strong as when first packed; left for twenty-four hours, nearly all electric energy had apparently disappeared. Replaced in their jars, they recovered sufficiently to drive an electromotor, and to decompose water rapidly.

The cell which had not been touched was as strong after twenty-four hours as when first charged.

One cell which had been charged for two hours was unrolled, and the plate which had been connected with the negative end of the Callan was examined.

On separating the felt so as to leave undisturbed the coating of oxide on the lead plate, this oxide appeared of a dirty white colour, and on lifting up this coating the surface in contact with the metal presented the appearance of pulverulent metallic lead.

On the outer surface of the lead plate, charged from the positive pole, a dark brown colour was observed. On the inner surface a nearly black powder had been formed.

The respective lead plates of the combination being then placed on one another, pressed together, and the terminals connected with a platinum wire, the latter became red hot. On reducing the pressure much less heat was given out. The lead plates were then rolled up, replaced in acid, and worked out. These being again unrolled and examined, the coating of material on the plate which had been connected with the zinc, or negative, pole of the battery was found to have lost its metallic appearance, and to have become of a dirty white colour, both inside and out. The coating of material on the plate which had been connected with the positive pole of the battery was not nearly so dark in colour as when charged. I noticed after a week or so that the first charge of acid was not sufficient to keep the secondary battery properly in action, and that the latter required more primary current to get the same effect. It, however, seemed to recover after a time upon the addition of fresh acid of 1 in 10 strength.

Before paper or parchment paper was used in the con-

struction of the battery the effects produced were very similar to those observed in the case of the original Plante secondary element, the effects merely lasting for a very short time.

Parchment paper, from its toughness, has been found by me to be best adapted for the preparation of secondary elements.

The oxide of lead should, previous to applying it to the lead plate, be well mixed with the acid. If water simply be used for this purpose the cells are with difficulty charged, and oxygen and hydrogen gases are given off, the lead oxide being only decomposed on the outer surfaces.

After a time it was observed that the lead terminal which in charging had been connected with the positive pole of the battery had become brittle, possibly from absorption of oxygen.

It may be observed that the chemical action going on in the Faure battery is not at present well understood; but it seems that the first action which takes place consists in the removal of the lower oxide present in the red lead by the action of the sulphuric acid with the formation of lead sulphate.

In charging the lead plates, which, as arranged, may be looked upon as a form of voltameter, the one connected with the positive pole of the primary battery becomes surcharged with oxygen, while in the plate connected with the negative pole hydrogen is absorbed with the formation of water and reduction of the oxide of lead to the metallic state.

The metallic lead so formed, being in a very porous condition, may then be capable of absorbing large quantities of hydrogen.

Two Callans cells put on to one cell of the Faure battery cause a considerable disengagement of free hydrogen, whilst apparently no oxygen was eliminated.

In the case of the same number of Callans used with four secondary cells nothing like so much gas was evolved.

Unfortunately, up to the present, I have been unable to charge the instrument by means of the dynamic machine, either by using an intensity or a quantity armature.*

For the use of these machines I am indebted to the kindness of Messrs. Josephs and Danks.

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* NOTE.—Since the paper was read, we have succeeded in charging the secondary cells by making them part of the circuit of a dynamic machine in the act of producing light. Curiously enough, under these circumstances, the electric light appeared, if anything, better and steadier.